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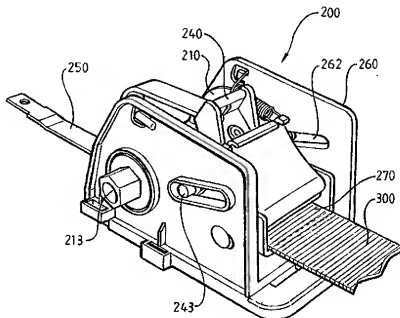
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[Continued on next page]

(54) Title: SEAT BELT RETRACTION MECHANISM



(57) Abstract: A belt retraction mechanism (200) including a biased spool (210) having a belt (300) wound thereon, the spool (210) biased to retract the belt (300), a pawl and ratchet mechanism for preventing rotation of the spool (210) in a direction of retraction, a biased cam member having an engagement surface, the cam member biased to an engagement position wherein the engagement surface engages the belt (300) thereby preventing movement of the belt (300) and moveable to an open position, and an actuator (240) moveable between an open setting and a closed setting, wherein the actuator (240) is manually operable to the open setting to release the pawl and ratchet mechanism and furthermore cause the cam member to move from the engagement position to the open position, thereby allowing the belt (300) to be moveable.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SEAT BELT RETRACTION MECHANISM

FIELD OF THE INVENTION

The present invention relates to a belt retraction mechanism. In one particular form, the present invention relates to a seat belt retraction mechanism for a child restraint seat.

BACKGROUND OF THE INVENTION

Current seat belt retraction mechanisms typically involve a combination of a spring loaded spool in combination with an associated ratchet and pawl arrangement. The pawl is spring loaded to engage a tooth of the ratchet thereby preventing rotation of the spool. However, the standard ratchet and pawl arrangement has a significant disadvantage. This is best illustrated by considering Fig. 1 which shows a seat belt retractor 100 having a spool 110 biased to retract the belt in an anti-clockwise direction (direction of curved arrow). The teeth 120 of the ratchet 115 have a first generally front vertical face 121 and a rear sloped face 122. In the event of the belt being pulled from the retractor 100 (direction of straight arrow), the pawl 130 abuts against the vertical face 121 thus locking the belt against any movement from the retractor 100.

In operation, the pawl 130 is first released from the ratchet 115 by an actuator thus allowing the spool 110 to rotate and the belt to be removed under tension from the spool 110. Following fitting of the belt over the child, often in combination with other separate belt and/or buckle portions, the belt retracts under tension and the pawl 130 is allowed to re-engage with the ratchet 115 and thus the child is suitably restrained. However, the pawl 130 will often engage with the intermediate rear sloped surface 122 of a tooth 120 between two adjacent vertical faces 121. Thus when pulling the belt from the retractor, the spool 110 will move clockwise until the pawl 130 positively engages and abuts against the next vertical face 121. This implies that there is a certain amount of belt that will travel out from the retractor 100 before the pawl 130 and ratchet 115 mechanism locks the belt.

As a sudden clockwise direction of the spool 110 would be symptomatic of an accident, where the momentum of the child would act to remove the belt from the retractor 100, the extra amount of the travel in the belt will loosen the restraint

5 resulting in a potentially dangerous and unsafe situation.

It is an object of the present invention to provide a belt retraction mechanism which enables improved belt locking.

10 SUMMARY OF THE INVENTION

In one aspect the present invention accordingly provides a belt retraction mechanism including:

a biased spool having said belt wound thereon, said spool biased to retract said belt;

15 a pawl and ratchet mechanism for preventing rotation of said spool in a direction of retraction;

a biased cam member having an engagement surface, said cam member biased to an engagement position wherein said engagement surface engages said belt thereby preventing movement of said belt and moveable to an open position; and

20 an actuator moveable between an open setting and a closed setting, wherein said actuator is manually operable to said open setting to release said pawl and ratchet mechanism and furthermore cause said cam member to move from said engagement position to said open position, thereby allowing said belt to be moveable.

25 Combining a biased cam member that includes an engagement surface that locks the belt in position with a pawl and ratchet mechanism which prevents rotation of the spool provides an effective locking mechanism that locks the belt in place when the pawl and ratchet is engaged and the cam member is in the engagement position.

30 Combining these features with an actuator which functions to release both of the

separate locking means further results in a belt retraction mechanism that is convenient and easy to use.

5 Preferably, on actuation of said actuator from said open setting to said closed setting said pawl and ratchet mechanism reengages thereby preventing rotation of said spool.

10 This further simplifies the action of locking the seat belt retraction mechanism in position as the same actuator used to release the belt is also used to reengage the pawl and ratchet mechanism.

Preferably, on actuation of said actuator from said open setting to said closed setting, said cam member moves from said open position to said engagement position.

15 Once again this also greatly simplifies the operation of the seat belt retraction mechanism as use of a single actuator can both fully lock the belt in position or alternatively release the belt.

20 Preferably, said actuator includes biasing means, said biasing means to bias said actuator to said closed setting from said open setting on release of said actuator. This improves the safety of the belt retraction mechanism as the actuator is biased to a closed setting ensuring that the belt remains locked in position by default.

25 Preferably, said cam member is pivotable and includes a cam arm abutting said actuator, said cam arm located at an opposite end to said engagement surface, wherein on movement of said actuator to said open setting from said closed setting said cam member is caused to rotate from an engagement position to an open position.

By having the cam arm directly contacting the actuator, movement of the actuator can be used in a simple and effective manner to change the position of the cam member.

- 5 Preferably, said engagement surface engages said belt by gripping said belt between said engagement surface and an inlet surface, said inlet surface forming part of an inlet for said seat belt retraction mechanism into which said belt is retracted.

- 10 Preferably, whilst said actuator is in said closed setting, retraction of said belt causes said cam member to rotate to reduce the distance between said engagement surface and said inlet surface thereby causing said belt to be gripped more tightly. This further increases the safety aspects of the belt retraction mechanism as any sudden retraction of the belt such as would be encountered in an accident results in the belt being locked with greater force.

- 15 Preferably, said engagement surface includes a number of ridges or teeth to engage said belt.

- 20 Preferably, said actuator is retained in substantially linear slots to guide movement of said actuator when acting against said cam arm.

Preferably, said actuator further includes the pawl of said pawl and ratchet mechanism.

- 25 Preferably, said actuator and said pawl are of unitary construction.

Preferably, said actuator further includes a handle, said handle arranged to be operable from a location substantially opposite to said inlet of said belt retraction mechanism into which said belt is retracted. By positioning the handle opposite to

the inlet, one hand may be used to pull the belt from the belt retraction mechanism whilst the other hand operates the handle in a convenient and ergonomic position.

BRIEF DESCRIPTION OF THE DRAWINGS

- 5 A preferred embodiment of the present invention will be discussed with reference to the accompanying drawings wherein:

Fig. 1 is a side view of a prior art pawl and ratchet mechanism as employed in a seat belt retraction device;

- Fig. 2 is a first upper side perspective view of a belt retraction mechanism without the housing cover according to a preferred embodiment of the present invention;

Fig. 3 is a second upper side perspective view of the belt retraction mechanism illustrated in Fig. 2;

Fig. 4 is a sectional side view of the belt retraction mechanism including the housing cover illustrated in Fig. 2 in the engagement position; and

- 15 Fig. 5 is a sectional side view of the belt retraction mechanism illustrated in Fig. 4 in the open position.

In the following description, like reference characters designate like or corresponding parts throughout the several views of the drawings.

20 DESCRIPTION OF PREFERRED EMBODIMENT

- Referring now to Figs. 2 and 3, there is illustrated a belt retraction mechanism 200 according to a preferred embodiment of the present invention. Whilst this embodiment is directly applicable to the harness of a child restraint or safety seat, the invention could equally be applied to other situations where a lockable belt
- 25 retraction mechanism is required such as a safety harness for a seat or where belts are employed to secure goods whilst being stowed.

- Belt retraction mechanism 200 includes spool 210 upon which belt 300 is wound upon. Spool 210 is spring loaded by clockwork spring 212 which applies a rotating
- 30 force in an anticlockwise direction as depicted in Fig. 3 thereby retracting belt 300

into inlet 270 when the spool 210 is released. Equally other spring arrangements which bias the spool 210 to retract belt 300, such as a torsion spring or even resilient band arrangements are contemplated to be within the scope of the invention. To further tighten the belt 300 a shaft (not shown) can be mounted to engage the hexagonal nut 213 thus allowing manual rotation of the spool to tighten the belt 300.

Belt retraction mechanism 200 further includes actuator 240 mounted within housing 260 by protrusions 243 which slide in slots 262 located on each side of housing 260. Attached to actuator 240 is handle 250 which operates to move actuator 240 along slots 262.

Referring now to Fig. 4, actuator 240 also includes pawl 241 which in one position engages with the teeth of ratchet 211 which are located on one side of spool 210 and oriented to block retraction of the belt 300 onto spool 210. Attached to actuator 240 at slot 242 is coil spring 280 whose other end is attached to housing cover 290 at mounting point 291. Coil spring 280 functions to bias pawl 241 into engagement with ratchet teeth 211. Abutting actuator 240 is pivotable cam member 220 which consists of an arm portion 222 and cam engagement surface 221 which includes a plurality of teeth or ridges to improve gripping. Cam member 220 is pivotable about an axis defined by bolt 224 which attaches cam member 220 to housing 260.

Rotation of the cam member 220 in a clockwise direction as seen in Fig. 4 forces the cam engagement surface 221 against the belt 300. Withdrawal force applied to the belt 300 will cause the cam engagement surface 221 to grip the belt 300 and to urge it further in a clockwise direction thereby causing the belt 300 to be compressed between the cam engagement surface 221 and bottom surface 271. This will prevent withdrawal of the belt 300.

A coil spring 230 is attached to an upper lip 223 of arm portion 222 and is attached at its opposite end to a slot 261 in housing 260. Coil spring 230 acts to bias the cam

member 220 against actuator 240 when it is acting to release the cam member 220 and to further hold the cam engagement surface 221 against the belt 300 when there is clearance between the actuator 240 and cam member 220 to ensure that clamping of the belt occurs as soon as any withdrawal force is applied. Clearly, as would be
5 apparent to those skilled in the art, other biasing means may be used in substitution for coil spring 230.

Referring now to Figs. 4 and 5, in operation, handle 250 is pushed towards housing 260 causing actuator 240 to slide along slots 262 against the biasing action of both coil
10 springs 230, 280 thereby releasing pawl 241 from ratchet 211 and furthermore pivoting cam member 220 so that the cam engagement surface 221 is moved away from the belt 300 thereby releasing the belt 300. As pawl 241 is no longer preventing rotation of spool 210 and as belt 300 is free to move between cam engagement surface 221 and bottom surface 271, belt 300 will be retracted due to action of clockwork
15 spring 212. The belt 300 can also be withdrawn thereby tensioning clockwork spring 212. On release of handle 250, cam member 220 under the action of coil spring 230 and without any opposing force from actuator 240 will return to an engagement position where engagement surface 221 will grip belt 300 to prevent removal. Furthermore, actuator 240 including pawl 241 will be drawn towards spool 210 along
20 slots 262 to attempt to engage with ratchet teeth 211.

As cam member 220 moves to the engagement position a retraction force on the belt 300 will cause the cam member 220 to clamp the belt 300 virtually instantaneously. However, if no retraction force is applied, the clockwork spring 212 in spool 210 will
25 have sufficient force to rotate in an anti-clockwise direction (as seen in Fig. 4) until pawl 241 engages with the next ratchet tooth 211. Belt 300 pulled in this direction with respect to the cam member 220 will act to release the cam member 220 thereby allowing further retraction of the belt 300 until rotation of the spool is arrested by the ratchet 211, or the harness being tight on the occupant of the safety seat. Pivoting

cam member 220 takes the full load caused by any forced removal of belt 300 from belt retraction mechanism 200 once actuator 240 has been released.

In another embodiment, additional biasing means may be included to apply a greater force to the cam member 220 to urge it into more positive engagement with the belt 300 so that clamping of the belt occurs quickly without further movement of the cam member 220 being required from retraction force on belt 300.

As would be apparent to those skilled in the art, belt retraction mechanism 200 provides substantial advantages over the prior art. As the locking function is performed by the cam member 220 the disadvantages of prior art pawl and ratchet mechanisms are substantially addressed.

The invention has the advantage of holding the belt in its withdrawn position. For example, if the actuator 240 is operated and belt 300 withdrawn to extend the harness of the safety seat, then the harness and belt 300 will stay in that extended position when the actuator 240 is released. This is due to the pawl 241 engaging a ratchet tooth 211 which prevents rotation of the spool 210 in the direction of retraction. The belt 300 and the harness will retract as soon as the actuator 240 is again operated.

In an alternative embodiment, the pawl 241 and ratchet 211 may be deleted from the actuator 240 and spool 210. This will result in a positive retracting force always being applied to the belt 300 and will allow further tightening force to be applied manually to the spool 210. For example, a shaft mounted to, or engagable with, the spool 210 having an external handle could be used to further retract the belt 300 to maximise tension in the safety seat harness. The belt 300 would move freely past the cam member 220 when moving in this direction.

Although a preferred embodiment of the present invention has been described in the foregoing detailed description, it will be understood that the invention is not limited

to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the invention as set forth and defined by the following claims.

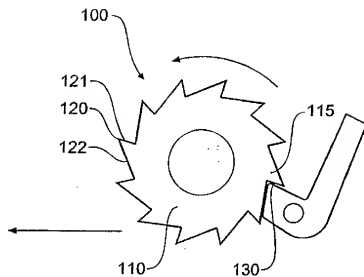
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS

1. A belt retraction mechanism including:
a biased spool having said belt wound thereon, said spool biased to retract
5 said belt;
a pawl and ratchet mechanism for preventing rotation of said spool in a
direction of retraction;
a biased cam member having an engagement surface, said cam member
biased to an engagement position wherein said engagement surface engages said belt
10 thereby preventing movement of said belt and moveable to an open position; and
an actuator moveable between an open setting and a closed setting, wherein
said actuator is manually operable to said open setting to release said pawl and
ratchet mechanism and furthermore cause said cam member to move from said
engagement position to said open position, thereby allowing said belt to be
15 moveable.
2. A belt retraction mechanism as claimed in claim 1, wherein on actuation of
said actuator from said open setting to said closed setting said pawl and ratchet
mechanism reengages thereby preventing rotation of said spool.
3. A belt retraction mechanism as claimed in claim 1 or 2, wherein on actuation
20 of said actuator from said open setting to said closed setting, said cam member
moves from said open position to said engagement position.
4. A belt retraction mechanism as claimed in any one of the preceding claims,
wherein said actuator includes biasing means, said biasing means to bias said
actuator to said closed setting from said open setting on release of said actuator.

5. A belt retraction mechanism as claimed in any one of the preceding claims, wherein said cam member is pivotable and includes a cam arm abutting said actuator, said cam arm located at an opposite end to said engagement surface, wherein on movement of said actuator to said open setting from said closed setting
- 5 said cam member is caused to rotate from an engagement position to an open position.
6. A belt retraction mechanism as claimed in claim 5, wherein said engagement surface engages said belt by gripping said belt between said engagement surface and an inlet surface, said inlet surface forming part of an inlet for said seat belt retraction
- 10 mechanism into which said belt is retracted.
7. A belt retraction mechanism as claimed in claim 6, wherein whilst said actuator is in said closed setting, retraction of said belt causes said cam member to rotate to reduce the distance between said engagement surface and said inlet surface thereby causing said belt to be gripped more tightly.
- 15
8. A belt retraction mechanism as claimed in any one of the preceding claims, wherein said engagement surface includes a number of ridges or teeth to engage said belt.
- 20 9. A belt retraction mechanism as claimed in any one of the preceding claims, wherein said actuator is retained in substantially linear slots to guide movement of said actuator when acting against said cam arm.
10. A belt retraction mechanism as claimed in any one of the preceding claims, wherein said actuator further includes the pawl of said pawl and ratchet mechanism.
- 25 11. A belt retraction mechanism as claimed in claim 10, wherein said actuator and said pawl are of unitary construction.

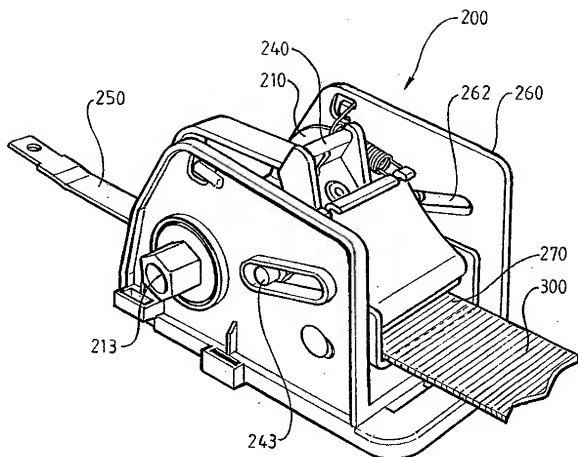
12. A belt retraction mechanism as claimed in any one of claims 6 to 11, wherein said actuator further includes a handle, said handle arranged to be operable from a location substantially opposite to said inlet of said belt retraction mechanism into which said belt is retracted.

1/4

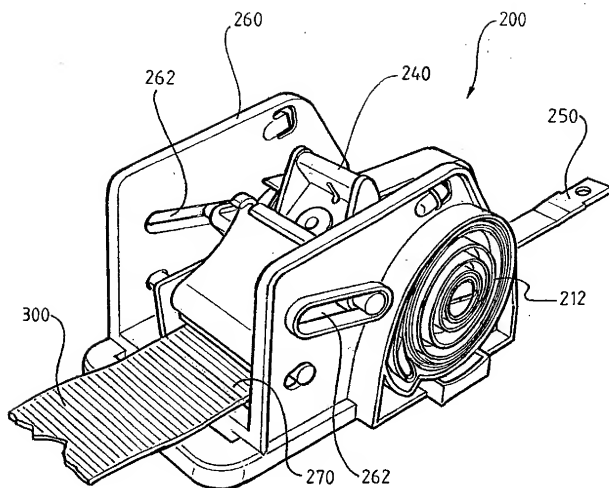
**Fig 1**

Prior Art

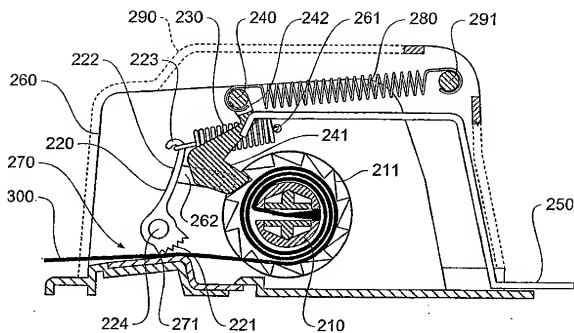
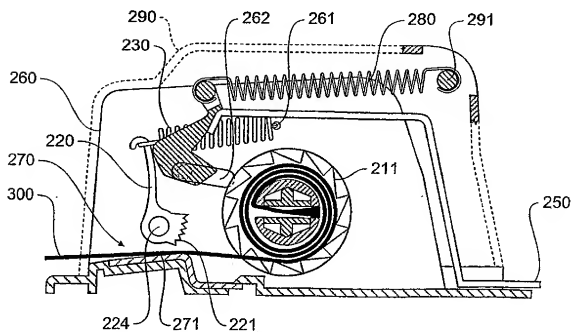
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**Fig 2**

3/4

**Fig 3**

4/4

**Fig 4****Fig 5**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2004/001591

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. ⁷: B60R 022/42, 022/36, 022/34, 022/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI: IPC B60R /IC, B65H /IC, A62B /IC and key words BELT, RESTRAIN etc., PAWL, CAM etc., ADJUST, RELEASE etc.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5681094 A (BROWN et al.) 28 October 1997 Whole document	1-2, 4, 8, 10
Y	US 5160186 A (LEE) 3 November 1997 Whole document	1-2, 4, 8, 10



Further documents are listed in the continuation of Box C



See patent family annex

- * Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search
14 December 2004

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2004/001591

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	5681094				
US	5160186	AU	53075/94	AU	73702/91
		EP	0449772	JP	4224441
		US	5031962	US	5286090
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.					
END OF ANNEX					